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LIST OF ANTIOXIDANTS PROPOSED FOR THE PRESERVATION OF EDIBLE FATS (WITH A SELECTED BIBLIOGRAPHY OF PAPERS AND PATENTS)

Bureau of Agricultural and Industrial Chemistry

No.	Substance(s)	Bibliography Item No.
1	Vegetable oils, including palm, kapok, hydrogenated sesame, hydrogenated soybean, crude cottonseed, and crude soybean oils	1,26,27,29, 30,46,51, see also 61
2	Solvent-extracted wheat germ oil, plus citric acid	34
3	Distillate from the steam deodorization of sesame oil	28
4	Tocopherols	53; see also 2,4,5,12,20, 32,52,55,56, 61,63,69,71
5	Hydroxy-chromans, hydroxycoumarans, and other compounds related to tocopherols (in combination with ascorbic acid)	41; see also 17,68
6	Naphthols, quinones, and quinoles (plus ascorbic acid and/or the compounds named under No. 5, above)	42; see also 18,40,52
7	Caffeic acid (alone or in combination with one or more of the following: ascorbic acid, tartaric acid, phosphoric acid, and the compounds named under No. 5, above)	43
8	Hexuronic acids, as for example, galacturonic and glucoronic acids (plus one or more of the compounds mentioned under Nos. 5 and 6, above)	44
9	"Lecithin" or phosphatides from soybean oil	6; see also 3,52,55,56, 61,63,69
10	Phosphatides from corn and cottonseed oils	72
11	Phosphatides from animal tissues	11
12	Phosphoric acid	13,59; see also 3,19,52, 55

13	Phosphorous acid or acid salts	58
14	Phosphoric acid-fatty acid esters of glycerol	16
15	Phosphoric acid-fatty acid esters of glycol, polyglycols, and polyglycerols	15
16	Reaction product of monoglycerides, phosphoric acid, and beta amino ethanol	65
17	Reaction product of fat, a phosphorous compound, as lecithin or phosphoric acid, and a sugar	49
18	Phosphoric acid esters of polyhydric phenols	38
19	Organic acids, including oxalic tartaric, maleic, malonic, malic, citric, pyruvic, succinic, fumaric, aconitic, etc.	23,24,64; see also 52,54,55
20	Ascorbic acid	21; see also 17,41, 42,43,44
21	Fatty acid monoesters of l-ascorbic and d-isoascorbic acids	62; see also 32,61,63
22	Reaction product of castor oil with citric, tartaric, or other organic acid, or maleic anhydride	31
23	Nordihydroguaiaretic acid	36; see also 32,63
24	Gum guaiac	25,50; see also 32,47
25	Southern sweet gum	37
26	Licorice resin	9
27	Residue from distillation of clove oil or other spice oil	45
28	Gallic acid, propyl gallate, and other gallates	22; see also 32
29	Condensation product of a polyphenol (as pyrogallol) with ketones, aldehydes, fatty acids, etc.	50,60,70

30	Phenol derivatives, such as methyl vanillate, methyl syringate, etc.	7
31	Phenolic compounds, as for example, vanillyl alcohol and coniferyl alcohol	33
32	Phenolic compounds, as for example, catechol monododecyl ether	66
33	High-molecular weight ortho- and para-polyhydroxy benzene compounds, as dodecyl catechol and dodecyl hydroquinone	67
34	Oat flour and other cereal flours and ground seeds and vegetable materials	48; see also 35,57
35	Catalase (as from ripened cheese)	8
36	Ethyl ester or other organic ester of tyrosine	39
37	Sugar amines or amine salts, as glucamine, methyl glucamine, lauryl glucamine, etc.	14
38	Hydroxamic acids	10

For the information and convenience of readers who may wish to purchase antioxidants, there are listed in the following paragraphs a number of firms engaged in the distribution of these materials. It is to be understood that this list is representative only, and does not include the names of all dealers in antioxidants. Complete lists of dealers may be found in Chemical Industries, Buyer's Guidebook Number, 19th Annual Revision, October 1943; Thomas' Register of American Manufacturers, Vol. 1, 1944, Thomas Publishing Co., New York; and similar buyers' guidebooks. The Department of Agriculture does not particularly endorse the firms mentioned or recommend their products above others.

Tocopherol concentrates (No. 4): Distillation Products, Inc., Rochester, New York. Wheat germ oil (which is high in tocopherol content): General Mills, Minneapolis, Minnesota. Wheat germ oil with citric acid added (No. 2): Viobin Corp., Monticello, Illinois.

Soybean lecithin (No. 9): American Lecithin Co., Elmhurst, New York; W. A. Cleary Corp., New Brunswick, New Jersey; Ross & Rowe, Inc., New York; Vejin, Inc., 944 W. 5th. St., Cincinnati, Ohio.

Gum guaiac (No. 24): S. B. Penick & Co., 50 Church St., New York; Lignum Vitae Products Corp., Jersey City, New Jersey; J. L. Hopkins Co., 220 Broadway, New York.

Nordihydroguaiaretic acid (No. 23): Wm. J. Stange Co., 2536 W. Monroe, Chicago, Illinois.

Oat flour (No. 34) (prepared under the trade name of "Avenex"): Quaker Oats Co., Cedar Rapids, Iowa.

Miscellaneous synthetic antioxidants (mostly inedible, but possibly in some cases suitable for edible products): E. I. duPont de Nemours & Co., Wilmington, Delaware.

The following points are to be remembered in connection with the use of antioxidants:

(a) A new antioxidant not derived from edible materials or not occurring in edible materials must be demonstrated to be non-toxic before it is acceptable for use in foods. All of the antioxidants claimed for edible materials have not been approved for use in these products.

(b) Many antioxidants are patented.

(c) The effectiveness of different antioxidants varies according to the fat in which they are used. Thus, for example, tocopherol concentrates are very effective in lard, but are generally ineffective in vegetable oils, because the latter usually have a natural tocopherol content near the optimum. Lecithin, phosphoric acid, and many other acid-type antioxidants are effective in most vegetable oils, but relatively ineffective in lard, because they do not function alone, but merely act synergistically with tocopherols, etc.

(d) Certain antioxidants (notably lecithin and phosphoric acid) lose their effectiveness, either wholly or partially, when the fats containing them are incorporated into baked goods.

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